REMARKS

To summarize, Claims 1-18 are pending, with Claims 1-18 previously rejected and Claims 10 and 15 objected to for minor informalities.

In response, Claims 10 and 15 have been amended as requested by the Examiner. No new matter has been entered. Based on the following remarks, reconsideration and allowance of the application are requested.

I. Objection to Claims 10 and 15

Claims 10 and 15 were objected to due to minor informalities. In response, Claims 10 and 15 have been amended in accordance with the Examiner's instructions.

II. 35 USC 103(a) Rejection based on Greene

Claims 6-8 and 15-17 were rejected under 35 U.S.C. §103(a) as being anticipated by Greene (U.S. Patent No. 6,646,639). Based on the following remarks, Applicant believes that the above-identified Claims are allowable over the cited prior art of Greene.

A. The Invention According to Independent Claim 6

The invention according to independent Claim 6 calls for a method of shading 3-D computer graphics images, comprising the steps of:

> subdividing a display for an image into a plurality of rectangular areas;
>
> for each object in the image determining a bounding box of rectangular areas into which the object may fall;
>
> testing edge information from each object against a sample point in each rectangular area to determine whether or not the object falls into each of the rectangular areas in the bounding box;

inserting the object in an object list for a rectangular area in dependence on the result of the determination; and

characterized in that the step of testing edge information includes the step of shifting the edge information by a predetermined amount in dependence on the orientation of each edge

(emphasis added).

B. The Reference of Greene

In contrast to the invention called for by independent Claim 6, Greene fails to disclose a graphics system that tests edge information from each object against a sample point by "shifting the edge information by a predetermined amount in dependence on the orientation of each edge".

Instead, Greene discloses a more traditional graphics system that determines whether a polygon overlaps a specific cell by calculating the edges of the polygon, and then comparing the x and y coordinates of the image sample in question to the defined polygon edges to determine whether those coordinates lie outside that edge. Specifically, "for each of the polygon's edges, it is determined whether the current cell lies outside that edge by substituting the appropriate point into its edge equation, which has the form Ax+By+C=0." (See Greene, 23:28-34) "To determine whether an image samples lies outside an edge, its x and y coordinates are substituted into the edge's equation and the sign of the result is checked." (See Greene, 23:44-48) Thus, each coordinate in question is tested against each edge of the polygon by substituting the x and y coordinate values into each of the equations representing a specific edge of the polygon.

Unlike the system and method disclosed in Greene, Claim 6 calls for a method of shading graphics wherein the process of determining whether an object falls into a defined rectangular

area includes the step of "shifting the edge information by a predetermined amount in dependence on the orientation of each edge". As a result, the claimed method is able to process an object using a uniform sampling location, e.g., the top left corner of the tile. In contrast, traditional methods such as that disclosed in Green requires the selection of sample points on an edge-by-edge basis.

The logic behind the claimed method is that, rather than moving a test point as a function of the edge (as done in Greene), each edge will be shifted so that the same test point can be used for the testing of all the edges of a polygon. Thus, Greene is seen to disclose a traditional method whereby an object is processed by utilizing a defined fixed edge and variable sampling or test points. In contrast, the claimed method utilizes the same test point with "variable" edges that can be adjusted or shifted by a predetermined amount based on the orientation of each edge. As a result, the claimed method advantageously requires a fewer number of sampling points.

To emphasize the above-noted distinction, consider column 23, lines 51-57 of Greene, which discloses that in order to determine whether a square lies entirely outside an edge of a polygon, a sample point must be determined. Furthermore, Greene determines this sample point by selecting the corner point of the current cell that is subsequently determined to be farthest away from the edge in the inside direction. (See Greene, 23:51-57) Thus, for each cell, a determination has to be made as to which corner to use as the sample point. In contrast to the above example of Greene, the method of Claim 6 allows for a single sample point to be selected without reference to the edge data, with the edge data being shifted to determine whether or not any overlap exists.

The Office Action asserts that Greene discloses the shifting of edge information in dependence on orientation, citing column 26, lines 3-7 as support, which discloses that

"the equations can be evaluated efficiently with shifts and adds". However, review of this section in context reveals that Greene is neither disclosing nor suggesting the shifting of an edge in screen space dependent on edge orientation. Instead, this section references a well known short cut approach used in computer binary arithmetic for evaluating certain equations by shifting the bits of the binary representation. For example, if an expression is of the form A to 2M, and if A has a value of 19 which is represented in binary form as 10011, the subsequent multiplying of A by 4 (e.g., M equals 2) can be accomplished by adding two zeros to the original binary number to obtain 1001100, which is the binary equivalent of the answer, which is 76 in decimal form. Accordingly, Greene's discussion of shifting is merely a reference to the binary shifting technique for effecting multiplication, and not to any process of translating or moving the position of an edge in screen space so as to reduce the number of sampling points.

Based on the above, Applicant believes that Claim 6, and those claims dependent therefrom, overcome any rejection based on the reference of Greene.

C. The Invention According to Independent Claim 15

Claim 15 is an apparatus claim that corresponds to method Claim 6. Furthermore, Claim 15 calls for "means for shifting the edge information by a predetermined amount in dependence on the orientation of each edge". Accordingly, for the reasons set forth above with respect to Claim 6, Applicant believes independent Claim 15, along with those claims dependent therefrom, overcome any rejection based on the reference of Greene.

III. 35 USC 103(a) Rejection based on Greene and Xavier

Dependent Claims 9 and 18 were rejected under 35 U.S.C. §103(a) as being anticipated by Greene in view of Xavier (U.S. Patent No. 6,099,573). Specifically, the Office Action

asserts that Greene discloses the claimed invention except for the use of a safety margin. Xavier is subsequently cited to supplement this specific deficiency of Greene.

However, as discussed above, Greene neither discloses nor suggests a system or method of shading 3-D graphics that includes the shifting of edge information by a predetermined amount in dependence on the orientation of each edge. Xavier, which discloses a method of modeling interactions, also fails to disclose or suggest the shifting of edge information in dependence on edge orientation.

Accordingly, it is believed that Claims 9 and 18 overcome any rejection based on the references of Greene and Xavier, considered individually or in combination.

IV. 35 USC 103(a) Rejection based on Greene and Koneru

Claims 1-5 and 10-14 were rejected under 35 U.S.C. §103(a) as being anticipated by Greene in view of Koneru (U.S. Pub No. 2003/0122819). Based on the following remarks, Applicant believes that the above-identified Claims are allowable over the cited prior art.

A. The Invention According to Independent Claim 1

The invention according to independent Claim 1 calls for a method of shading 3-D computer graphics images, comprising the steps of:

> subdividing a display on which an image is to be viewed into a plurality of rectangular areas;
>
> for each rectangular area deriving a list of objects in the image which may be visible in that rectangular area;
>
> using the list of objects to determine how the rectangular area should be shaded for display;
>
> characterized in that the step of deriving a list of objects comprises the steps of:

determining maximum and minimum values for each object in x and y directions;

determining a set of sampling points from the maximum and minimum values;

determining whether or not a bounding box surrounding the object covers any of the sampling points; and

adding or rejecting the object from the list in dependence on the result of the determination

(emphasis added).

B. The References of Greene and Koneru

The Office Action asserts that Greene discloses the invention as claimed except for the determination of maximum and minimum values. Koneru is then cited to supplement this specific deficiency of Greene.

However, in contrast to Claim 1, Greene fails to disclose a method of shading graphics wherein the process determines the minimum and maximum values in the x and y directions for each object, and then determines a set of sampling points from these minimum and maximum values.

The Office Action asserts that Green teaches the determination of sampling points based upon the vertices of an object, which are based on maximum and minimum calculations, citing Figures 14 and 15 as support. However, upon further review, Applicant believes this cited section does not show the defining of a bounding box around a primitive to be tested, nor the defining of a set of sample points dependent on the maximum and minimum values of x and y of the object within the bounding box. Instead, Greene teaches a well defined method of sampling objects utilizing an "overlap test" as discussed starting at column 23, line 23. According to this overlap test method, Greene processes a number of tiles by testing the edge equations of a polygon against every

sample point in the tile. Greene neither discloses nor suggests the setting of a set of sampling points in dependence of the minimum and maximum values for each object, or equivalently, the size of the bounding box for the object.

Koneru, which discloses a method for determining bins to be updated for polygons, is cited to supplement Greene. However, similar to Greene, Koneru also fails to disclose the setting of a set of sample points in dependence of the minimum and maximum values for each object. Koneru does disclose the use of a bounding box, but not for the purpose of determining where sample points should be positioned. Instead, Koneru discloses that the bounding box is used in the process of "binning", where bin refers to the abstract buffer associated with a zone and which is usually realized as a series of instruction batch buffers. Specifically, Koneru utilizes a bounding box to determine which bins, associated with zones lying inside the bounding box, should be updated. Minimum and maximum values of a polygon are used to determine a bounding box, which is subsequently used to optimize use of the bins. However, similar to Greene, Koneru neither discloses nor suggests the determination of sample points based on minimum and maximum values of an object.

Accordingly, it is believed that independent Claim 1, along with those claims dependent therefrom, overcome any rejection based on the references of Greene and Koneru.

For similar reasons, it is believed that independent Claim 10, which is an apparatus claim corresponding to method Claim 1, along with its dependent claims, overcome any rejection based on Greene and Koneru.

All objections and rejections having been addressed, it is respectfully submitted that the present application is in condition for allowance, and a Notice to that effect is earnestly solicited.

Respectfully submitted,

Steven R. Thiel

SRT/cc

FLYNN, THIEL, BOUTELL
& TANIS, P.C.
2026 Rambling Road
Kalamazoo, MI 49008-1631
Phone: (269) 381-1156
Fax: (269) 381-5465

Dale H. Thiel	Reg. No. 24 323
David G. Boutell	Reg. No. 25 072
Terryence F. Chapman	Reg. No. 32 549
Mark L. Maki	Reg. No. 36 589
Liane L. Churney	Reg. No. 40 694
Brian R. Tumm	Reg. No. 36 328
Steven R. Thiel	Reg. No. 53 685
Donald J. Wallace	Reg. No. 43 977
Sidney B. Williams, Jr.	Reg. No. 24 949

Encl: Post Card

136.07/05